

**PRIORITY PRINTING****BACKGROUND OF THE INVENTION**

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**1. Technical Field:**

The present invention relates to printing in a network environment. More specifically, the invention relates to controlling the priority of print jobs.

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**2. Description of Related Art:**

In a computer network environment, network users must often share the same printing resources. If several network users are attempting to use the same printer at roughly the same time, significant delays will occur in the printing of high priority print jobs. In fact, a single large print job can delay several smaller print jobs. This essentially allows one person to disrupt the work of several people, leading to considerable productivity problems for the entire network. If several people are attempting to print large print jobs, the congestion can become even more severe. However, the problem is not limited to large print jobs. If too many print jobs enter the printing queue, it will result in delays and productivity loss, even if the print jobs individually are small.

As with any other scarce resource, printing resources in a computer network must be allocated according to specific rules which determine priority. Considerations giving rise to priority among competing print jobs can include, for example, the size of the print jobs, the relative importance of particular

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projects, the status of network users within an organization, as well as any other factor that may determine why one print job should be printed before competing print jobs.

- 5           However, print priorities must also be flexible and should be able to adjust to changing network printer traffic. As computer networks become larger and more complicated, more focus should be given to the ability to manage and adjust the resources of the network as
- 10   circumstances change, something that cannot be done with automatic, bright line priority rules. The work performed by individual network users often changes in priority. Therefore users may wish to change their printing priorities accordingly and should be able to
- 15   request a desired level of priority for their submitted print jobs. However, there should also be some central control on the part of a network administrator, who would be in a better position to evaluate the total demand placed on the network's printing resources.
- 20           The prior art does not provide much power to network administrators and users to control the priority of how and when print jobs print, and the ability to change printing priorities as circumstances rapidly evolve. Therefore, a method that allows network administrators
- 25   and users to control the priority of print jobs, while providing the flexibility to adjust to changing work priorities and network demands, would be desirable.

**SUMMARY OF THE INVENTION**

The present invention provides a method for managing  
5 printing priorities in a computer network environment.  
The method includes setting the priorities of network  
print jobs. These priority settings can be determined by  
a network administrator and/or network users. The  
priority of a new print job entering the print queue is  
10 compared to the priority of other jobs already in the  
queue. If there are print jobs in the queue with higher  
priority than the new print job, the new job is delayed  
until the higher priority jobs have finished printing.

In one embodiment, if the new print job has the  
15 highest priority in the queue, its priority is compared  
to any job currently printing. If the new print job has  
a higher priority than the job currently printing, the  
current job is suspended until the new job prints in  
full. The suspended job is then resumed.

20 In another embodiment, the priority settings can be  
changed by the network administrator and/or the network  
users, according to changing circumstances.

**BRIEF DESCRIPTION OF THE DRAWINGS**

The novel features believed characteristic of the  
5 invention are set forth in the appended claims. The  
invention itself, however, as well as a preferred mode of  
use, further objectives and advantages thereof, will best  
be understood by reference to the following detailed  
description of an illustrative embodiment when read in  
10 conjunction with the accompanying drawings, wherein:

**Figure 1** depicts a pictorial representation of a  
distributed data processing system in which the present  
invention may be implemented;

**Figure 2** depicts a block diagram of a data  
15 processing system which may be implemented as a server,  
in accordance with the present invention;

**Figure 3** depicts a block diagram of a data  
processing system in which the present invention may be  
implemented; and

20 **Figure 4** depicts a flowchart illustrating a method  
for setting and managing network printing priorities in  
accordance with the present invention.

**DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT**

With reference now to the figures, and in particular  
5 with reference to **Figure 1**, a pictorial representation of  
a distributed data processing system is depicted in which  
the present invention may be implemented.

Distributed data processing system **100** is a network  
of computers in which the present invention may be  
10 implemented. Distributed data processing system **100**  
contains network **102**, which is the medium used to provide  
communications links between various devices and  
computers connected within distributed data processing  
system **100**. Network **102** may include permanent  
15 connections, such as wire or fiber optic cables, or  
temporary connections made through telephone connections.  
In the depicted example, server **104** is connected to  
network **102**, along with storage unit **106**. In addition,  
clients **108**, **110** and **112** are also connected to network  
20 **102**. These clients, **108**, **110** and **112**, may be, for  
example, personal computers or network computers.

For purposes of this application, a network computer  
is any computer coupled to a network that receives a  
program or other application from another computer  
25 coupled to the network. In the depicted example, server  
**104** provides data, such as boot files, operating system  
images and applications, to clients **108-112**. Clients  
**108**, **110** and **112** are clients to server **104**. Distributed  
data processing system **100** may include additional  
30 servers, clients, and other devices not shown.  
Distributed data processing system **100** also includes

printers **114**, **116** and **118**. A client, such as client **110**, may print directly to printer **114**. Clients such as client **108** and client **112** do not have directly attached printers. These clients may print to printer **116**, which is attached to server **104**, or to printer **118**, which is a network printer that does not require connection to a computer for printing documents. Client **110**, alternatively, may print to printer **116** or printer **118**, depending on the printer type and the document requirements.

In the depicted example, distributed data processing system **100** is the Internet, with network **102** representing a worldwide collection of networks and gateways that use the TCP/IP suite of protocols to communicate with one another. At the heart of the Internet is a backbone of high-speed data communication lines between major nodes or host computers consisting of thousands of commercial, government, education, and other computer systems that route data and messages. Of course, distributed data processing system **100** also may be implemented as a number of different types of networks such as, for example, an intranet or a local area network.

**Figure 1** is intended as an example and not as an architectural limitation for the processes of the present invention.

Referring to **Figure 2**, a block diagram of a data processing system which may be implemented as a server, such as server **104** in **Figure 1**, is depicted in accordance with the present invention. Data processing system **200** may be a symmetric multiprocessor (SMP) system including a plurality of processors **202** and **204** connected to system

bus **206**. Alternatively, a single processor system may be employed. Also connected to system bus **206** is memory controller/cache **208**, which provides an interface to local memory **209**. I/O bus bridge **210** is connected to  
5 system bus **206** and provides an interface to I/O bus **212**. Memory controller/cache **208** and I/O bus bridge **210** may be integrated as depicted.

Peripheral component interconnect (PCI) bus bridge **214** connected to I/O bus **212** provides an interface to PCI  
10 local bus **216**. A number of modems **218-220** may be connected to PCI bus **216**. Typical PCI bus implementations will support four PCI expansion slots or add-in connectors. Communications links to network computers **108-112** in **Figure 1** may be provided through  
15 modem **218** and network adapter **220** connected to PCI local bus **216** through add-in boards.

Additional PCI bus bridges **222** and **224** provide interfaces for additional PCI buses **226** and **228**, from which additional modems or network adapters may be  
20 supported. In this manner, server **200** allows connections to multiple network computers. A memory mapped graphics adapter **230** and hard disk **232** may also be connected to I/O bus **212** as depicted, either directly or indirectly.

Those of ordinary skill in the art will appreciate  
25 that the hardware depicted in **Figure 2** may vary. For example, other peripheral devices, such as optical disk drives and the like, also may be used in addition to or in place of the hardware depicted. The depicted example is not meant to imply architectural limitations with  
30 respect to the present invention.

The data processing system depicted in **Figure 2** may

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be, for example, an IBM RS/6000, a product of International Business Machines Corporation in Armonk, New York, running the Advanced Interactive Executive (AIX) operating system.

5       With reference now to **Figure 3**, a block diagram of a data processing system in which the present invention may be implemented is illustrated. Data processing system **300** is an example of a client computer. Data processing system **300** employs a peripheral component interconnect (PCI) local bus architecture. Although the depicted example employs a PCI bus, other bus architectures, such as Micro Channel and ISA, may be used. Processor **302** and main memory **304** are connected to PCI local bus **306** through PCI bridge **308**. PCI bridge **308** may also include an integrated memory controller and cache memory for processor **302**. Additional connections to PCI local bus **306** may be made through direct component interconnection or through add-in boards. In the depicted example, local area network (LAN) adapter **310**, SCSI host bus adapter **312**, and expansion bus interface **314** are connected to PCI local bus **306** by direct component connection. In contrast, audio adapter **316**, graphics adapter **318**, and audio/video adapter (A/V) **319** are connected to PCI local bus **306** by add-in boards inserted into expansion slots. Expansion bus interface **314** provides a connection for a keyboard and mouse adapter **320**, modem **322**, and additional memory **324**. In the depicted example, SCSI host bus adapter **312** provides a connection for hard disk drive **326**, tape drive **328**, CD-ROM drive **330**, and digital video disc read only memory drive (DVD-ROM) **332**. Typical PCI local bus implementations will support three or four PCI



expansion slots or add-in connectors.

An operating system runs on processor **302** and is used to coordinate and provide control of various components within data processing system **300** in **Figure 3**.

5 The operating system may be a commercially available operating system, such as AIX, which is available from International Business Machines Corporation. "AIX" is a trademark of International Business Machines Corporation. An object oriented programming system, such as Java, may  
10 run in conjunction with the operating system, providing calls to the operating system from Java programs or applications executing on data processing system **300**. Instructions for the operating system, the object-oriented operating system, and applications or  
15 programs are located on a storage device, such as hard disk drive **326**, and may be loaded into main memory **304** for execution by processor **302**.

Those of ordinary skill in the art will appreciate that the hardware in **Figure 3** may vary depending on the  
20 implementation. For example, other peripheral devices, such as optical disk drives and the like, may be used in addition to or in place of the hardware depicted in **Figure 3**. The depicted example is not meant to imply architectural limitations with respect to the present  
25 invention. For example, the processes of the present invention may be applied to multiprocessor data processing systems.

In reference to **Figure 4**, a flowchart illustrating a method for setting and managing network printing  
30 priorities is depicted in accordance with the present invention. The process begins by setting priorities for network print jobs (**step 401**). In the example of **Figure**

4, the priorities are set by a network administrator. The criteria used for establishing print priorities can include, for example, the size of the print jobs, the status of network users within an organization, and the  
5 importance of the project associated with a print job. In addition, the priorities do not have to be based on only one type of criteria. A combination of criteria can be used in setting print priorities within the network.

In one embodiment of the present invention, the  
10 print priorities can be established in whole or in part by the network users themselves. A network user, upon submitting a print job, can specify the degree of importance of the print job. For example, the user could specify 1 for high priority or 5 for low priority. A  
15 priority of 1 would be used if the user wants the job to print as soon as possible. A priority of 5 would be used if the user is in no immediate need to print, but would still like the job to be printed. An example of a 5 priority would be printing a large manual that the user  
20 does not need right away. These priorities can be determined entirely by the users themselves, or a network administrator can review the priorities requested by users and make adjustments according to overall network traffic.

25 Another embodiment would allow the network administrator to set print priorities and then allow network users to override those priorities according to changing circumstances. This provides flexibility in adjusting network printing priorities without having to  
30 constantly go through a central administrator.

The priorities of print jobs can be changed after a print job has entered the printing queue, whether the

priorities are changed by the network administrator or users. This allows priorities to adjust to changing circumstances, which is necessary when dealing with large computer networks. The prior art does not allow for this type of flexibility in adjusting print priorities. Prior art approaches rely on fixed, bright line rules, which function automatically and do not allot much power to network administrators or users for determining and changing print priorities, as circumstances dictate.

Once printing priorities have been established, a network user sends a print job to the printing queue (**step 402**). A print queue is disk space in a computer system that holds data output designated for a printer, until the printer can receive it. Print queues are necessary because printing generally occurs at much slower speeds than most other computer applications. When an application is requested to print a document, it immediately generates the output on disk. The output is then fed to a print spooler, which manages printing in the computer. Spooling (Simultaneous Peripheral Operations OnLine) is used to buffer data when low speed operations overlap with normal processes. A print spooler feeds printing images to a printer at the slower printing speed. The print image is a text or graphics document that has been prepared for a printer. Format codes for the required printer are imbedded in the document. The printing is then done in the background while higher speed applications are performed in the foreground.

The priority of the new print job is compared to the priority of other print jobs that might already be in the queue (**step 403**). If the new print job does not have the

highest priority in the queue, it is postponed until higher priority print jobs have finished printing (**step 404**). If the new print job does have the highest priority in the queue, the next step is to determine if it has a higher priority than the job currently printing (**step 405**).

If the current print job has a higher priority, the new print job is postponed until the current job is complete (**step 406**). If the new print job has a higher priority, the current job is suspended (**step 407**), and the new job prints in full (**step 408**). After the new print job is complete, the suspended print job is resumed (**step 409**), assuming that another higher priority job has not entered the print queue. Different colored sheets can be used to separate different print jobs and portions of print jobs.

It is important to note that the order of print jobs in the printing queue can change not only in response to new print jobs entering the queue, but also in response to changes in the priority settings made by the network administrator and/or users.

As new print jobs enter the queue, the relative priority and estimated completion time for a given print job is likely to change several times. It is important for a network user to be aware of when his or her print job will be finished. Therefore, the present invention provides a graphical user interface (GUI) for informing the network user of the estimated time remaining until the print job is complete. If the print job has already started printing, the GUI will inform the user of the estimated time remaining until the print job is finished. It is important to note that this estimated time

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remaining will be dynamic and will update itself based upon network printer traffic and jobs that enter the printing queue.

In the case when a print job has not yet begun to  
5 print, the GUI will give the user an estimate of how long it will be before the job is finished. Based on this information, the user can decide whether or not to proceed. The GUI can send prompts at set time intervals, updating the user as to the estimated time to completion.  
10 The user can choose to keep the print job in the queue or cancel the job.

As new print jobs enter the queue, or as priority rules are changed by the administrator and/or users, the priority of a particular print job might change several  
15 times. This presents the risk of low priority print jobs being perpetually sent to the back of the queue or interrupted by higher priority jobs. To avoid this problem, the present invention allows a maximum time limit to be set for delaying any particular print job.  
20 For example, a limit of 12 hours might be set as the maximum amount of time a print job can be delayed before printing in full.

It is important to note that while the present invention has been described in the context of a fully  
25 functioning data processing system, those of ordinary skill in the art will appreciate that the processes of the present invention are capable of being distributed in the form of a computer readable medium of instructions and a variety of forms and that the present invention  
30 applies equally regardless of the particular type of signal bearing media actually used to carry out the distribution. Examples of computer readable media

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include recordable-type media, such as a floppy disk, a hard disk drive, a RAM, CD-ROMs, DVD-ROMs, and transmission-type media, such as digital and analog communications links, wired or wireless communications links using transmission forms, such as, for example, radio frequency and light wave transmissions. The computer readable media may take the form of coded formats that are decoded for actual use in a particular data processing system.

- 10       The description of the present invention has been presented for purposes of illustration and description, and is not intended to be exhaustive or limited to the invention in the form disclosed. Many modifications and variations will be apparent to those of ordinary skill in the art. The embodiment was chosen and described in order to best explain the principles of the invention, the practical application, and to enable others of ordinary skill in the art to understand the invention for various embodiments with various modifications as are suited to the particular use contemplated.
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